PETITION

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Your Petitioners, Ghassem Zarbi and Rory Bjarnason, citizens of Canada and residents of the Province of British Columbia, whose residence and mailing address for Ghassem Zarbi is 30585 Progressive Way, Abbotsford, British Columbia, Canada V2T 6W3 and for Rory Bjarnason is 30585 Progressive Way, Abbotsford, British Columbia, Canada V2T 6W3, pray that Letters Patent Protection be granted to them for an

IMPROVED COOLING FAN MECHANISM FOR A MOTOR-DRIVEN PRESSURE WASHER

as set forth in the following specification:

Background of the Invention

1. Technical Field

The present invention is directed to pressure washers and, more particularly, to an improved cooling fan mechanism for a motor-driven pressure washer which includes a generally toroidal drive pulley rotatably mounted within the pressure washer which is driven by an engine within the pressure washer, the drive pulley including a generally cylindrical outer rim having outer and inner sides, a central hub and a plurality of spokes extending between the central hub and the outer rim for supporting the outer rim in spaced relation from the central hub with at least some of the plurality of spokes of the drive pulley each consisting of an angled, generally planar fan blade having a forward air-engaging edge generally adjacent the outer side of the outer rim and a

rearward edge generally adjacent the inner side of the outer rim, the forward air-engaging edges of the fan blades operative to engage air upon rotation of the drive pulley and force air into the pressure washer via the fan blades to cool the interior of the pressure washer thereby reducing the internal temperature of the elements of the pressure washer.

2. Description of the Prior Art

Pressure washers are incredibly versatile and effective cleaning tools. They can be used for vehicle cleaning, removing stains, moss and mildew from brickwork, driveways, paths, patios and even garden furniture. With the right attachment they can even be used for cleaning and unblocking drains.

Pressure washers generate a high-speed, focused jet of water by using a powerful motor to pump water (usually fed from a garden hose) to very high pressures. This produces a high speed, highly penetrating jet of water that is directed by a long handled lance at the object to be cleaned. Pressure washers are also extremely efficient and use as little as 1/10 the volume of water used by an ordinary garden hose.

Pressure washers fall into two main categories:

i. Cold water pressure washers take water fed directly from the cold water main supply and pump it out at high pressures (70 - 270 bar or 1000 to 4000 psi). On better quality machines, a siphon tube or reservoir permits the addition of special detergents to aid cleaning. There is a mechanism attached to this siphon tube that prevents back flow and city water contamination. Cold water pressure washers are excellent at removing organic matter, mud,

dirt and all water-soluble compounds. They will also remove fats, oils and greases but work much better if degreasing compounds are worked into these non-soluble compounds first.

ii. Hot water pressure washers work in the same way as their cold water counterparts but heat the water up (before pumping) to 100°C - 140°C in an internal boiler. Hot water pressure washers can be modified to be used as steam cleaners. Steam cleaners require an electricity supply and a liquid fuel such as heating oil or paraffin to heat the boiler.

Hot water pressure washers are excellent at removing very heavy deposits of oils and greases from the objects being cleaned and tend to leave a drier surface afterwards. Hot water pressure washers are also especially useful for stripping off old, hardened underseal. Because they can strip away non-soluble compounds without the need for a degreasing solution, they should only be used where the waste run-off passes through a special oil/water separator. Hot water pressure washers are considerably more expensive than cold-water cleaners.

The two conventional predominant pressure washer systems in use today are belt-drive and electric pressure washers. They rely on an engine to run the system and a water pump to pump the water at very high pressures. The direct-drive is for applications not requiring more than 30 hours of use per week. The pump is directly coupled to the engine or motor causing the pump to spin twice as fast as the belt drive models.

The belt-drive is most commonly found on industrial models and is ideal for cleaning applications requiring 40+ hours of use per week. The belt connecting the engine to the high-pressure pump

generates heat due to the high friction between the pulleys and belt. The generated temperature rises to a temperature close to, or even sometimes higher than the limit of the belt and causes the thermal expansion of the belt material thus promoting the development of belt shredding and slip problems. The heat is also transferred to pump and other key components through conduction, which results in an additional rise in their operational temperature. There is therefore a need for an improved cooling fan mechanism which will decrease the operational temperature of the components of the pressure washer thereby enhancing the cycling life of belts, pump and other key components of the belt-drive unit.

Without sufficient system airflow, many of today's pressure washer systems would overheat. Air can flow passively through system (this is the least expensive and most reliable form of cooling) or it can be driven through the system by a fan or blower. When a fan is required, system requirements will drive the selection of the right fan for the application, such as system pressure drop, acoustic restrictions, reliability requirements, and product mobility. Each of these may play a role in the choice of the fan system.

Fans can be thought of as low-pressure air pumps that utilize power from a motor to output a volumetric flow of air at a given pressure. A propeller converts torque from the motor to increase static pressure across the fan rotor and to increase the kinetic energy of the air particles. Each fan has only one design point, which is established by a specific airflow, total pressure, air density, and fan speed. Starting with these data, it is possible

to determine one platform and the twist distribution, which will accomplish the required work with minimum horsepower.

To move air, the fan must overcome two resistances, which are measured as pressure drops across the fan. The first is a parasitic loss called the velocity pressure loss, which is the energy required to move the required air quantity without doing any work to overcome the system resistance. However, work is being done to move the hot air away from the equipment. The second resistance is the static pressure loss, which is the accumulated loss due to inlet louver, fill, drift eliminator, and fan inlet pressure drop, etc. This represents the work to be accomplished and reflects the design of the total system. Whether the air is distributed evenly across the fan is primarily a function of the blade and hub design. A properly designed blade will have adequate chord width and twist to ensure an even distribution of velocity pressure over its entire length. A properly designed hub will include a center air-seal disk, which prevents negative airflow into the center of the fan.

The selection procedure for the fan requires an optimum fan diameter, number and type of blades, required pitch angle, fan rpm, and some estimate of horsepower. In some cases, an estimated sound-pressure level is essential to satisfy Environmental Protection Agency (EPA) requirements for working area noise levels, more importantly noise level at a plant boundary, or a given noise sensitive location such as a residential area.

The factors that must be known when installing or replacing a fan on an existing installation are:

- Fan diameter.

Installed engine horsepower.

- Gear reduction ratio of gear reducer.

Shaft size or gear reducer model.

- Some estimate of elevation above sea level of installation.

However, it is not always expedient to undertake such a detailed review of the replacement or installation needs for a cooling fan for the pressure washer, particularly in light of the relatively inexpensive nature of many pressure washers. It is far more preferable, then, that the pressure washer include an integral cooling fan mechanism, one which does not require the user of the pressure washer to perform significant additional functional determinations to allow proper operation of the cooling fan mechanism.

Therefore, an object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers.

Another object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which includes a drive pulley mounted on the engine which includes at least one generally planar fan blade replacing at least one of the spokes of the drive pulley for directing air into the interior of the pressure washer as the drive pulley is rotated.

Another object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which includes a generally toroidal drive pulley rotatably mounted within the pressure washer which is driven by an engine within the pressure washer, the drive pulley including a generally cylindrical outer rim having outer and inner sides, a central hub and a plurality of spokes extending between the central hub and the outer

rim for supporting the outer rim in spaced relation from the central hub with at least some of the plurality of spokes of the drive pulley each consisting of an angled, generally planar fan blade having a forward air-engaging edge generally adjacent the outer side of the outer rim and a rearward edge generally adjacent the inner side of the outer rim, the forward air-engaging edges of the fan blades operative to engage air upon rotation of the drive pulley and force air into the pressure washer via the fan blades to cool the interior of the pressure washer thereby reducing the internal temperature of the elements of the pressure washer.

Another object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which generally eliminates the need for additional cooling fan units to be used with the pressure washer.

Another object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which provides a cooling air flow for the majority of the operational elements of the pressure washer and will provide additional volume of air movement as the rotational speed of the engine is increased.

Another object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which is usable with many different types of pressure washers, and is not proprietary to any one specific unit.

Finally, an object of the present invention is to provide an improved cooling fan mechanism for motor-driven pressure washers which is relatively simple and durable in construction and is safe and efficient in use.

Summary of the Invention

The present invention provides an improved cooling fan mechanism for a motor-driven pressure washer which includes a generally toroidal drive pulley rotatably mounted within the pressure washer which is driven by an engine within the pressure washer, the drive pulley including a generally cylindrical outer rim having outer and inner sides, a central hub and a plurality of spokes extending between the central hub and the outer rim for supporting the outer rim in spaced relation from the central hub with at least some of the plurality of spokes of the drive pulley each consisting of an angled, generally planar fan blade having a forward air-engaging edge generally adjacent the outer side of the outer rim and a rearward edge generally adjacent the inner side of the outer rim, the forward air-engaging edges of the fan blades operative to engage air upon rotation of the drive pulley and force air into the pressure washer via the fan blades to cool the interior of the pressure washer thereby reducing the internal temperature of the elements of the pressure washer.

Prior to undertaking the preliminary and conceptual design of the present invention, a market survey was conducted through Internet searching, patent and literature searching, and by contacting various manufacturers. The combination of fan-pulley and belt-drive system in a pressure washer unit has not been attempted in the past as the market survey showed. There is a particular potential demand for the design that could offer temperature reduction and lifetime extension in each component. With existing conventional belt-drive pressure washer systems, the temperature of each component increases as the device operates, and

this component heating reduces the lifetime and efficiency of the device.

The cooling fan mechanism for motor-driven pressure washers as thus described provides several advantages not found in the prior art. For example, because it is the drive pulley which incorporates the fan elements of the present invention, additional drive mechanisms for a separate fan blade unit are rendered unnecessary. Also, the positioning of the fan blades within the drive pulley permits the airflow directed by the rotation of the fan blades to immediately access and cool the internal functional elements of the pressure washer, and an external fan unit would not be able to access the same area for cooling without interfering with the safety and operation of the pressure washer operational elements. Furthermore, the elimination of external fan units will greatly reduce the risk of injury from contact with the rotating fan blades, as the fan blades of the drive pulley are protected within the housing. Finally, because the cooling fan mechanism for motor-driven pressure washers of the present invention is capable of being retrofitted onto existing pressure washer units, the unique benefits of the invention can be added to many already manufactured units. It is thus seen that the cooling fan mechanism for motor-driven pressure washers of the present invention provides a substantial improvement over those devices found in the prior art.

Brief Description of the Drawings

Figure **1** is a perspective view of the motor-driven pressure washer with the improved cooling fan mechanism of the present invention fitted thereon;

Figure **2** is a front elevational view of the cooling fan mechanism of the present invention showing the modified drive pulley;

Figure **3** is a perspective view of the modified drive pulley of the present invention;

Figure **4** is a detailed exploded perspective view of the motor-driven pressure washer of the present invention showing the various elements thereof;

Figure **5** is a rear side elevational view of the internal features of the motor-driven pressure washer; and

Figure **6** is an end elevational detailed view of the motor-driven pressure washer and cooling fan mechanism of the present invention showing air being drawn into the unit and distributed to the internal operating elements of the motor-driven pressure washer.

Description of the Preferred Embodiment

The improved cooling fan mechanism **10** of the present invention is best shown in Figures **1-4** as being mounted on a motor-driven pressure washer **80** for improved cooling of the engine, pump and belts of the motor-driven pressure washer **80**. Before beginning the discussion of the improved cooling fan mechanism **10**, a brief description of the general features of the motor-driven pressure washer **80** is needed in order to understand the functional characteristics of the improved cooling fan mechanism **10**. As shown best in Figures **1** and **4**, the motor-driven pressure washer **80** would include a base platform **82** having wheels **84a** and **84b** and a forward ground-engaging stand **86** mounted on the underside of the base platform **82**. A handle **88** would project upwards from the base platform **82** for moving the motor-driven pressure washer **80**. A gasoline or electric-powered engine **90** is mounted on the base platform **82**, the engine **90** including a power output shaft **92** which is rotated by the engine **90**. Also mounted on base platform **82** rearwards of engine **90** is a water pump **94** which is connected to the power output shaft **92** of engine **90** via a drive belt **96** or the like. If the output speed of the power output shaft **92** of engine **90** is generally constant, the relative speed of rotation of water pump **94** is controlled by the relative size of drive pulley **12** mounted on power output shaft **92** of engine **90** and water pump drive pulley **98** mounted on the drive shaft **95** of water pump **94**. Finally, the entire drive belt mechanism is enclosed within a safety housing **100**, as shown best in Figures **1** and **4**.

To this point, the motor-driven pressure washer **80** of the present invention is of a generally standard type, and would

further include a hookup hose (not shown) to connect the water pump **94** to a water source, a high-pressure hose **102** connected to the outflow of the water pump **94** and a trigger-controlled gun with a flow-through wand handle **104** connected to the high-pressure hose **102** which is used in the standard pressure washer manner. However, the present invention provides a significant improvement over those pressure washer devices found in the prior art, in that the motor drive pulley **12** includes modifications which enable the motor drive pulley **12** to not only drive the water pump **94**, but also provide cooling for the motor-driven pressure washer **80** of the present invention.

Specifically, the motor drive pulley **12** would include a plurality of fan blades **14** which replace the standard spokes extending between the center axle hub **16** and generally cylindrical outer rim **18** of the motor drive pulley **12**. In the preferred embodiment, the motor drive pulley **12** would have a diameter of approximately six to twelve inches (6" to 12") and would be constructed of a rigid material such as cast iron, aluminum or other such high-strength metal. As each of these fan blades **14** are preferably constructed in a similar manner, the following description of one of the fan blades **14** should be understood to apply equally to each of the fan blades **14**. Fan blade **14** is preferably constructed as including a generally flat air deflection plate **18**, having a forward air-engaging edge **30** generally adjacent outer edge **20** of outer rim **18** and a rearward edge **32** generally adjacent inner edge **22** of outer rim **18**, as shown best in Figure **3**. It is further preferred that the air deflection plate **28** be angled at an angle of approximately ten to forty-five degrees (10° to 45°)

from perpendicular to the center axis of the motor drive pulley **12** as per a standard fan blade to deflect air encountered during the rotation of the fan blade **14** towards the inner edge **22** of outer rim **18** and inwards to the internal elements of the motor-driven pressure washer **80**, including the engine **90** and water pump **94**. Also, it should be noted that the precise size and shape of the air deflection plate **28** is not critical to the present invention so long as the air encountering the air deflection plate **28** is deflected inwards towards and past inner edge **22** of outer rim **18** as described above. In fact, it is expected that slight concave curvature of the air deflection plate **28** of fan blade **14** may be desirable in order to provide additional air propulsion towards the internal elements of the motor-driven pressure washer **80**. Also, the number of fan blades **14** is not critical to the present invention so long as at least one of the spokes **13** of motor drive pulley **12** are constructed as fan blades **14** to deflect and drive air for cooling purposes into the interior of the motor-driven pressure washer **80**.

Another important feature of the present invention is the inclusion of louvers **50** positioned in the sidewall of drive belt housing **100** adjacent the outer edge **20** of outer rim **18**, as shown best in Figures **1** and **4**. These louvers **50** permit the entry of cooling air into the drive belt housing **100** as drawn in by the rotating action of the fan blades **14** on motor drive pulley **12**. The cooling air thus brought in through louvers **50** acts to cool the drive belt **96** and thus increase the lifespan of the drive belt **96**.

Positioned on the opposite side of drive belt housing **100** is a metal mesh screen **52** positioned adjacent the inner edge **22** of

outer rim **18** of motor drive pulley **12**. The metal mesh screen **52** serves two purposes, the first being to permit transfer of cooling air driven by rotational action of the fan blades **14** on motor drive pulley **12** from the drive belt housing **100** into the vicinity of the engine **90** for cooling thereof, and the second purpose being to screen and prevent potentially harmful solid debris from being directed into the engine **90** via the action of fan blades **14** of motor drive pulley **12**. Of course, it should be noted that various other types of air passage structures may be used with the drive belt housing **100** of the present invention which permit the passage of cooling air to the engine **90** and drive belt **96**, but it has been found that the drive belt housing **100** which includes the louvers **50** and metal mesh screen **52** provides a safe, yet efficient, arrangement of elements which permit the passage of cooling air to the critical elements of the motor-driven pressure washer **80**.

It is to be understood that numerous additions, modifications, and substitutions may be made to the improved cooling fan mechanism **10** of the present invention which fall within the intended broad scope of the appended claims. For example, the size, shape, and construction materials used in connection with the improved cooling fan mechanism **10** and motor-driven pressure washer **80** of the present invention may be modified or changed so long as the intended functional features of the invention are maintained. Furthermore, the precise size, shape, number and angle of the fan blades **14** on motor drive pulley **12** may be modified or changed depending on the cooling characteristics desired and speeds at which the motor drive pulley **12** will be rotated, and such modifications to those fan blades specifics may be determined via experimentation and

operation. Also, as was stated previously, the precise size, shape, and design of the drive belt housing **100**, louvers **50**, and metal mesh screen **52**, may be modified or changed so long as the intended functional characteristic of permitting passage of cooling air from the outside of the drive belt housing **100** there through and into the engine **90** is maintained or enhanced. The present invention may also include a plurality of rubberized vibration dampers **101** mounted on the drive belt housing **100** should the use of such vibration dampers be desired. Finally, the layout of the features of the motor-driven pressure washer **80** may be modified or changed according to various manufacturers' designs, but it should be noted that the motor drive pulley **12** having at least one fan blade **14** thereon is a critical element of the improved cooling fan mechanism **10** of the present invention and may be adapted or modified for use with many different types of motor-driven pressure washers.

There has therefore been shown and described an improved cooling fan mechanism for a motor-driven pressure washer which accomplishes at least all of its intended objectives.